

MASSACHUSETTS  
AGRICULTURAL EXPERIMENT STATION

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BULLETIN NO. 358

FEBRUARY 1939  
REVISED JUNE 1950

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**Blueberry Culture in Massachusetts**

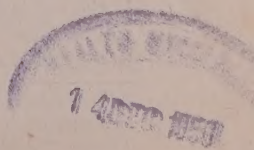
By JOHN S. BAILEY, HENRY J. FRANKLIN,  
and JOSEPH L. KELLEY

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Although the wild blueberry is native to New England, there was little interest in its improvement until cultivated varieties attracted attention. Since then, there has been a demand for information on varieties and cultural methods which this bulletin aims to supply.

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UNIVERSITY OF MASSACHUSETTS  
AMHERST, MASS.



## BLUEBERRY CULTURE IN MASSACHUSETTS

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BLUEBERRIES, although not peculiar to the New England States, grow wild here in great profusion. Massachusetts has received her full share of this gift from Mother Nature.

But man, being hard to please, was not satisfied with Nature's gift. He wanted sweeter and larger berries. To satisfy this desire, the late Dr. F. V. Coville of the United States Department of Agriculture started his pioneering work on the culture and breeding of blueberries, work which laid the foundation for their commercial cultivation. He produced and named several varieties with fruit larger and more handsome than that of their wild ancestors. These varieties were developed from the highbush or swamp blueberry, *Vaccinium corymbosum* L., and have the growth habit, and soil and climatic requirements of that species. Dr. Coville received valuable help from Miss Elizabeth C. White of New Lisbon, New Jersey, who provided much of the first stock for his breeding work and was a pioneer in developing commercial production.

Although relatively few acres of improved blueberries have been planted in Massachusetts, there is a fast growing interest in their culture which has led to a large demand for information about them. This bulletin is meant to serve as a guide to those interested in blueberry growing. To make it more useful, suggestions are given for better management of wild blueberry lands.

### Soil Requirements

Because the highbush blueberry commonly grows in low, swampy places, many people have the false notion that this blueberry thrives best in such locations. It grows there because it tolerates such conditions better than many other plants and so has less vegetation to compete with. Removed from such competition, the swamp blueberry thrives much better on a fertile soil than on a poor one.

The ideal blueberry soil is fertile, has a plentiful and continuous water supply, is well drained and aerated, is well supplied with organic matter, and is acid.

Since success with cultivated blueberries depends on producing large crops of big berries, the plants must be kept highly vigorous. The need for strong growth is all the greater because of the severe pruning which is usually practiced. A fertile soil is therefore important.

A steady, adequate water supply is essential. A soil which dries out, even for short periods, will never do for blueberry growing unless water is somehow supplied. However, too much water is as bad as too little. During the winter the freezing and thawing of a wet soil lifts the plants and breaks their roots (Fig. 1). If the soil is flooded deeply enough to prevent freezing and thawing, no harm will be done. Blueberry plants will tolerate flooding from the first of November to the first of April. At other times surplus water is always harmful. The water

<sup>1</sup>The authors wish to thank Mr. F. E. Cole, formerly of the Worcester County Extension Service, for supplying the information for the section on the improvement of wild highbush blueberries. This information was obtained from experiments started by Mr. Herbert Reiner, formerly with the Worcester County Extension Service.





Figure 1. Blueberry Plants lifted out of the ground by freezing of the soil. This location is too wet. It should have been drained before the plants were set.

table (the upper limit of the part of the ground that is saturated with water) in a blueberry soil must be at least 14 inches below the surface. If it is not, the land must be drained before blueberries are planted.

How essential organic matter is under all soil conditions, is not known. A good supply is very necessary with light sandy soils but heavier, more fertile ones may not need so much. However, experiments and experience indicate that the plants grow much better if the soil has a plentiful supply of organic matter.

Blueberries require an open, well-aerated soil for their best development. Wild bushes in swampy places grow in hummocks where their roots are out of water and well aerated during the growing season. Even where moisture conditions are more favorable, blueberries thrive best in an open, well-aerated soil.

The blueberry needs an acid soil. It will grow in a range of pH 3.4 to 6.5 (lower pH values mean higher acidity and vice versa). It has been shown that blueberries will grow at pH 3.4 but their growth is reduced in such extremely acid soils and they will respond favorably to lime application. When the soil reaction is about 5.8 or above, the leaves of the plants may develop a mottled appearance (Fig. 2) because they cannot get enough iron for healthy growth. This condition occurs most often on light, dry soils, low in organic matter. Best growth usually results where the soil has a pH range of 4.5 to 5.0. Most unlimed soils of Massachusetts are strongly acid (pH 4 to 5.5), but small areas of limestone origin in Berkshire County have surface soils which are only slightly acid and subsoils even less acid or neutral.

This State has much land suitable for blueberries. A growth of wild swamp blueberry, leatherleaf, cranberry, white cedar, or red maple indicates a favorable soil. Low meadows are often suitable if there is adequate air and water drainage. Hillsides may be used if the soil conditions are right and soil erosion is prevented.

Some abandoned cranberry bogs in the southeastern part of the State probably would be satisfactory. Land used for garden crops is usually unfit for blueberries because it is not acid enough. It often may be made suitable by mixing with it woodland turf, fallen leaves, or peat, using at least a bushel per plant.

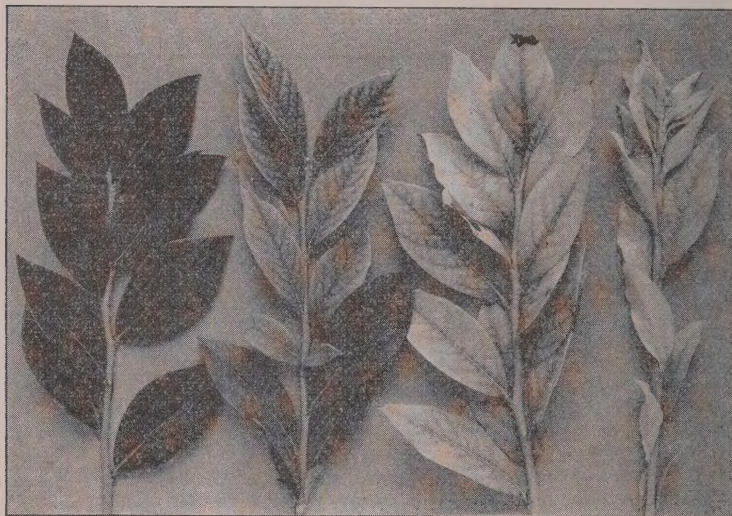


Figure 2. Iron Chlorosis of the Cultivated Blueberry.  
Healthy shoot at left; increasingly severe stages of chlorosis to the right. This should not be confused with blueberry stunt symptoms.

### Preparation of Land

If the land has not been under cultivation, it must be cleared of all trees, stumps, and bushes. If it is wet, it must be drained so that the water table will remain at least 14 inches below the surface. Low spots should be filled in or drained so there will be no standing water during the growing season.

After the land has been cleared and drained, the soil will be put in better condition if it is plowed and thoroughly harrowed. A sod often harbors white grubs which will eat off the roots of young plants. Where a sod is plowed up, it is usually safer to leave the land fallow for a year with an occasional harrowing to condition the soil and control the grubs.

### Selection of Varieties

Although the blueberry is relatively new among cultivated fruits, several desirable varieties are available. The bush of the ideal variety is able to produce a heavy crop and abundant new growth at the same time. It is easy to propagate and prune, disease resistant, especially to mummy berry, blueberry stunt, and *Phomopsis* gall, and hardy in winter. An upright habit of growth makes picking easy and keeps the berries out of the dirt.

The berries of the ideal variety are large and uniform in size throughout their season. Blue color, plenty of bloom over the surface, and pleasing flavor are desirable; good keeping and shipping quality are essential. The sepals, which



remain as part of the fruit, are small and closely appressed. The skin is as thin and tender as is possible without sacrificing shipping quality. The berries hang to the bushes well and separate from the stem with a small dry scar and without tearing the skin.

Early varieties, because of competition from cultivated berries from farther south, will probably be less profitable in Massachusetts than late ones. In some localities their crops may be reduced by spring frost oftener than those of later varieties. However, early varieties have a place in some plantings to start the season's local or roadside trade.

Four varieties are recommended for commercial planting in Massachusetts: Pioneer, Concord, Rubel, and Jersey.

**Pioneer** is a mid-season variety, ripening from middle to late July. It produces large crops of berries superior in appearance, flavor, and keeping quality. The bush is of medium height and fine appearance for ornamental planting. It is hard to propagate and costly to prune. This variety is especially favored in the Cape Cod section.

**Concord** is another mid-season variety, ripening with Pioneer. The bush is tall, upright, vigorous, and very productive. The berries are large, fine flavored, and attractive. The clusters are very compact so that the first picking is not so easy as with most varieties. Concord is quite susceptible to mummy berry but in spite of this it yields well. It is fairly easy to propagate and prune. It has not yielded well in the Cape Cod section but grows and bears well in the central and northern part of the State.

**Rubel** is a late variety, ripening a few days after Pioneer. It is a good producer. The berries are only fair in size, but their color and quality are good and they ship well. The bush is tall, upright, well shaped, vigorous, and easy to propagate and prune. Because of less competition from the South, this is one of the most profitable varieties in this State.

**Jersey** ripens with Rubel. The bush is very vigorous, productive, and easy to propagate and prune, but does not sprout from the base as freely as is desirable. The berries have good color, size, and keeping quality, and good flavor when well ripened. The stems are long, making the cluster so open that the berries are easily picked. The calyx lobes protrude, detracting somewhat from the appearance of the fruit.

**Cabot**, although a poor variety, is the best of the early ones. It ripens three or four days ahead of Pioneer and about a week ahead of Rubel. It yields good crops of large berries, but the fruit lacks flavor, does not hang to the bush well when ripe, and cracks badly after rains. The plants are spreading in type and not so vigorous as those of Pioneer or Rubel. They are hard to propagate, costly to prune, and very susceptible to winter injury and to the blueberry stunt and Phomopsis gall diseases.

**Pemberton** is a promising variety introduced in 1940. The fruit is unusually large, attractive, and fine flavored. It ripens about with Jersey. Its worst fault is its bad scar. The skin is apt to tear in picking. The bush is upright, very vigorous, productive, and winter hardy. It is easy to prune and is said to be easy to propagate.

**Atlantic** is one of the newer varieties. The fruit is about medium in size, a good blue, attractive and good to excellent in flavor, and has a good scar. It tends to crack after rains, doesn't hang to the bush well when ripe, and is somewhat susceptible to mummy berry. It ripens just ahead of Rubel. The bush is upright, spreading, fairly vigorous, and productive.

**Burlington**, another of the newer varieties, ripens after Rubel. The fruit is about medium in size, a good blue, has good flavor and a very good scar. The bush is upright, spreading, fairly vigorous, and very productive. It is very susceptible to mummy berry but appears to have the capacity to yield well in spite of this. Late ripening season and heavy production appear to be its main advantages.

**Dixi** has never gained much popularity. It is of value mainly because of the exceptionally large size and attractiveness of its fruit. The bush is upright, spreading, and fairly vigorous, but not a heavy producer. The fruit is only fair in flavor, has a rather large watery scar and a good blue color. It is slightly susceptible to mummy berry and occasionally cracks after rains. It ripens late, with Rubel or a little later.

**Wareham** is a late variety, ripening with Rubel or a little later. The bush grows vigorously, is easy to propagate and prune, and yields heavily. The berries have excellent flavor and develop good size throughout the season; but are dark in color, crack badly after rains, and do not ship well. This is a good home-garden variety.

**Berkeley** and **Coville**, two varieties introduced in 1949, have not had sufficient trial under Massachusetts conditions to show what their value is. Berkeley appears to ripen a little earlier than Rubel. The berries are very large and attractive but rather mild in flavor. Coville ripens five days after Rubel. Its berries are very large, attractive, and fine flavored when fully ripe.

Figure 3 gives the ripening season at Amherst of a few of the most commonly grown varieties.

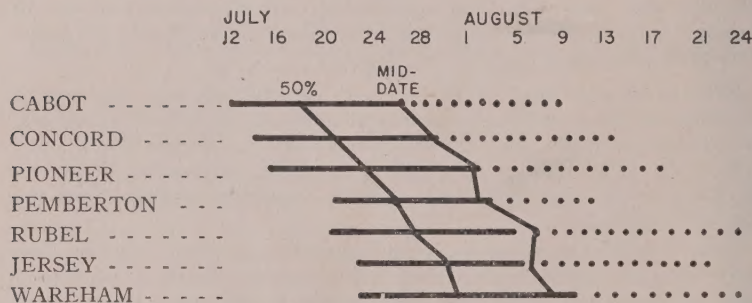


Figure 3. The Average Picking Season for Blueberry Varieties at Amherst, Mass.

The cross-line marked 50% indicates the date on which half of the crop had been picked; the cross-line marked mid-date indicates the middle of the picking season for each variety. The dotted part of each horizontal line shows when the last 15 percent of the crop was picked. This last 15 percent is very important in late varieties because the late berries bring the highest prices.

### Propagation

An ordinary cold frame is satisfactory for propagating. About six inches of propagating medium is necessary and it should be leveled. The best medium is a mixture of about equal parts by volume of peat and sand. Peats vary considerably as to parent material, physical condition, and chemical properties. Of the several types available, an acid peat such as sphagnum is the most desirable; neutral or alkaline peats are not suitable. The fineness of the peat is also im-



portant. That of horticultural or GPM grade is best. Peat coarser than this is of little use. Finer grades will need more sand mixed with them. Finely ground, acid leaf mold mixed with sand has also been used successfully for propagating blueberries. Peat must be wet before it is used. It is hard to wet with cold water, but hot water wets it easily. A quarter inch of clear sand over the bed reduces weed trouble and facilitates watering. A wire screen under the bed prevents root injury by grubs.

Successful handling of the propagating bed depends on the proper control of five factors: moisture in the propagating medium, aeration of the propagating medium, humidity in the propagating frame, light, and temperature. The first three are closely associated and practically are controlled together.

It is important that the propagating bed be kept moist but not water-soaked and soggy; hence very careful attention must be paid to watering. If the bed gets too wet, aeration is reduced, and the combination of too much water and too little air causes the cuttings to rot at the base and die.

The use of the right proportion of sand and peat for the propagating medium, good drainage below the bed to allow any excess water to drain away quickly, ventilation over the bed, and careful attention to watering all help to maintain good aeration in the propagation medium.

Humidity over the propagating bed is important because of the nature of the rooting process with blueberry cuttings. A short shoot with leaves is produced before rooting takes place. Enough humidity is needed to keep this new growth from wilting. On the other hand, if the humidity is too high, "damping-off" fungi may infect the new growth, causing it to lose its leaves and die. If signs of damping-off appear, it can sometimes be stopped by spraying the bed with a solution made by adding 1 teaspoonful of Semesan to 2 quarts of water. Humidity can be maintained by using glass sash over the beds.

The propagating bed must be kept from overheating by shading and ventilation. When the cuttings have grown leaves, they begin to make food for themselves if they have light enough. Therefore, they should be given all the light they will stand by raising the shades on cloudy days. The shades must be put back at once if the sun comes out, for even a few minutes of bright sunlight may do great harm.

The cuttings may be taken during the winter and stored in moist, but not wet, sphagnum or two-year-old sawdust (newer sawdust heats) until spring. Or the bushes may be pruned late in March and the cuttings, which must not be allowed to dry, taken at once from the prunings.

Cuttings are made from wood of the previous season's growth and must have no fruit buds. Weak, spindling cuttings are not desirable, as plants grown from them are usually small and slow in growth. Cuttings over a quarter inch in diameter seem to root less readily than medium-sized ones; but when they do root, they usually make large, vigorous plants. The best length is about four inches, with the top cut just above a bud and the bottom cut below and close to a bud. Cuttings can be made either with pruning shears or with a sharp knife.

The cuttings, beginning with the earliest varieties, should be put in the bed early in April before the buds begin to break. They may be set either at an angle of 45° or vertically, one inch apart, in rows two inches apart. If each cutting is placed deeply in the propagating medium with only the top bud out, usually only this bud will develop and a better plant will be produced.

After the cuttings have been set, the bed should be watered well and the sash put in place. The shades can be left off till the buds begin to break. This is desirable if the weather is cool. The shades may be of burlap or of slats supported about four inches above the sash. If they are made of slats, the proportion of

slats to space between them should be about three to one. The cuttings must be watched closely during the rooting period. If any begin to rot, the bed must be aired by raising the sash slightly.

Rooting of the cuttings is indicated by renewed top growth. It usually takes place late in June or early in July. After the cuttings begin to root, ventilation of the frames is started by shoving the sash up an inch or two from the bottom, gradually increasing this until it can be removed altogether. The light given the cuttings is gradually increased the latter part of August by removing the shades earlier in the evening and replacing them later in the morning until they are left off entirely.

After the cuttings have rooted, their growth can often be much improved by fertilization. This must be very carefully done because the young plants are very tender and can be killed easily by too much soluble fertilizer. New Jersey (5) recommends the following:

Make up a stock solution composed of

1 pound nitrate of soda

$\frac{1}{2}$  pound superphosphate (16 or 20 percent phosphoric acid)

$\frac{1}{4}$  pound sulfate of potash

8 gallons water

Allow this stock solution to stand for a day with occasional stirring. Discard the small amount of sediment which appears. Use 1 quart of stock solution in 2 gallons of water for 50 square feet of propagating bed. This solution can be applied with an ordinary sprinkling can. The first application is made after the cuttings root; subsequent applications at weekly intervals until mid-August. If unusually rank growth occurs, fertilization should be stopped earlier to allow the plants to harden off for winter. In Washington (10) it was found that ammonium phosphate, one ounce to 10 square feet of propagating bed applied dry and well watered in, gave good results. Application immediately after the cuttings were set gave as good growth response as an application made after rooting. However, applications made after leaves are out must be followed by thorough watering to wash any soluble fertilizer off the leaves or damage may result.

The young plants may be left in the cold frame during the winter with hay, straw, or like material over them for protection. In the spring they are set in a nursery to grow for a year or two before they are put in the field. The nursery should be cultivated well, but not deeply enough to disturb the roots of the plants. The judicious use of fertilizer in the nursery will give larger, sturdier plants. The first application should be delayed until the plants have become established, about a month after planting. Dribble a very thin band of fertilizer down each side of the row just beyond the root balls. Four pounds of a 7-7-7 will take care of 1000 plants. This application may be repeated a month later.

### Planting

Although some growers have set their plants successfully in the fall, spring planting is usually preferable in this climate. Plants should be set as early in the spring as the condition of the soil permits. The planting distance depends largely on the method of cultivation, the varietal characteristics of the plants, and the fertility of the soil. Plants grow larger and need more room on a very fertile soil than on a less fertile one. Vigorous varieties need more space than less vigorous ones. Large tractors and equipment require more room than hand or horse-drawn cultivators or garden type tractors. Room for cultivating machinery need not be considered under a mulching system. In no case should the plants



be set closer than 5 feet in rows 8 feet apart. So spaced, 1,089 per acre are required. The rows must be 10 feet apart for cultivation with a large tractor and tractor-drawn equipment. Although 5 feet between plants may be enough for some of the less vigorous growing varieties, 6 or even 8 feet is not too much for the very vigorous ones. It might be advantageous to prepare half the land, set the plants 4 feet in the rows, and in 3 or 4 years, when the plants begin to crowd, prepare the rest of the land and transplant every other bush, leaving the bushes 8 feet apart in the row.

When plants are sold by age, it seldom pays to set in the field plants less than two years old. Year-old plants are rooted cuttings and usually require a year in the nursery to become large enough to set in the field without high mortality. If plants are sold by size, those 12-18 inches tall are usually the best buy. Smaller plants are cheaper but take longer to come into bearing, and more are likely to be lost in transplanting. Larger plants cost more but come into bearing sooner.

Plants are shipped from the nursery with roots either bare or with a ball of earth around them, but they seem to get established in a new location more quickly if shipped with a ball of earth. If the roots are in a ball of earth, this should be disturbed as little as possible in transplanting. If they are bare, they should be well spread out in the planting hole. The holes for the plants should be dug large enough so the roots can be placed without crowding and deep enough so that about an inch of the stem is below the soil surface.

Blueberry varieties are nearly self-unfruitful under some conditions, so it is best to plant at least two varieties. They may be set in alternate rows if they are equally desirable. If not, at least every fourth row should be different.

### Soil Management

Blueberry plantings are usually kept cultivated from early spring till about mid-August. Cultivating after that may cause late growth and make the plants susceptible to winter injury.

Since blueberries are shallow-rooted, cultivation should not be deep, especially close to the plants. As a result of their experiments in New Jersey, Beckwith and Doehlert (2) recommended cultivating to an average depth of three inches between the rows but no nearer to the plants than the ends of the branches. They advise hand hoeing or very shallow cultivating with an acme harrow to check weeds close to the plants. This agrees with experience in Massachusetts that tillage is necessary to keep the soil from becoming packed and poorly aerated, but that deep cultivation close to the plants is harmful.

Mulching blueberry plantings has been very satisfactory. This makes cultivation unnecessary, adds organic matter to the soil, and conserves moisture. But mulch may be costly and hard to get, and dry mulch is a fire hazard. Sawdust has proved to be the best mulch for blueberries and is recommended where it can be obtained and applied without excessive cost. Pine needles, fallen leaves, peat, shavings, and waste hay or straw may be used also. Since hay and straw attract mice, a mouse-control program may be needed. Their presence can be detected in late summer or early fall by the runways which they make through the mulch. If they are present, a good poisoning program is indicated. For directions, communicate with your county agricultural agent or the U. S. Fish and Wildlife Service.

Most annual weeds will be suppressed if enough mulch is used. Sometimes, however, the amount of mulch needed to suppress all weeds will be excessive, and in such cases judgment and hand weeding will be necessary. Although chemical weeding of blueberries has been done experimentally, this has not reached the point where recommendations can be made.

### Fertilization

Blueberry plants respond readily to fertilization. Although nitrogen generally affects growth and yield most, experiments in New Jersey (2) indicate that a complete fertilizer is desirable because nitrogen used alone causes excessive shoot growth.

The young plants will get a better start if a little fertilizer is used the year they are set. Since they are very easily injured by too much soluble fertilizer, this must be done with great care. After the plants become established, as indicated by the start of new growth, one half ounce per bush may be scattered in a ring just outside the limits of the root ball. The application of such small amounts of fertilizer is easier if it is mixed with an equal amount of dry sand. The next year and each year thereafter through the fifth the amount given the preceding year may be doubled. By the sixth year the bushes will need 600 to 1000 pounds per acre, depending on their size and vigor. This heavy fertilization of the bearing bushes is recommended because vigorous shoots produce the largest and best berries and because abundant growth is needed to replace the wood removed in pruning.

Several different fertilizer mixtures have been used successfully by growers. A 7-7-7 fertilizer, that is, one containing 7 percent nitrogen, 7 percent phosphoric acid and 7 percent potash, is a standard mixture which has given good results. The amounts recommended are based on this mixture. However, any good equal parts ratio may be used if the amounts applied are adjusted to the analysis.

Under conditions where the nitrogen is rapidly lost from the soil by leaching, being taken up by weeds, tied up by mulches, or in any other manner, split fertilizer applications seem desirable. The first application is made in early May, just before blooming, and the second about a month later. If a single application is used it is made on the earlier date. Where cultivation is practiced, cultivation after fertilization is desirable.

The healthy growth of the bushes may not continue if the soil is not distinctly acid. It is better not to use soils with a pH above 5.5. Where they are in use, the acidity needs to be increased. A fertilizer like sulfate of ammonia, which leaves an acid residue in the soil, will help; and 200 pounds of sulfate of ammonia will give nearly the same amount of nitrogen as 600 pounds of a 7-7-7 mixture. An equal amount of phosphoric acid and potash will be supplied by using 300 pounds of a 0-14-14 mixture. Half the sulfate of ammonia and all of the superphosphate and potash can be applied at the time of the first fertilizer application; the balance of the nitrogen at the second.

When mulches are used, especially those like sawdust and straw, which contain very little nitrogen, the blueberry leaves are apt to turn yellow and red because of nitrogen starvation. Doubling the nitrogen application for a couple of years, until the mulch starts to break down, will usually overcome this trouble.

Those who have a few blueberry bushes in the back yard can use any good garden fertilizer or grass topdressing if a 7-7-7 mixture is not available.

### Pruning

Pruning is one of the more important operations in blueberry growing. It induces the growth of vigorous new shoots, prevents over-bearing, and stimulates the production of larger berries. It must be done in winter or early spring before growth starts.

The bushes need little pruning the first two years after planting; only short, weak branches need be removed. Since bearing during this period reduces growth



and delays the production of a commercial crop, the removal of the fruit buds during pruning is desirable. If any are missed, the flowers may be pulled off when the bushes bloom.

To prune bearing bushes correctly, one must know their bearing habit. The fruit buds are on the terminal part of the shoots. They form in the axils of leaves during the summer, remain dormant during the winter, then bloom and produce fruit the next summer. Fig. 7 shows shoots with their fruit buds (a) and leaf buds (b).

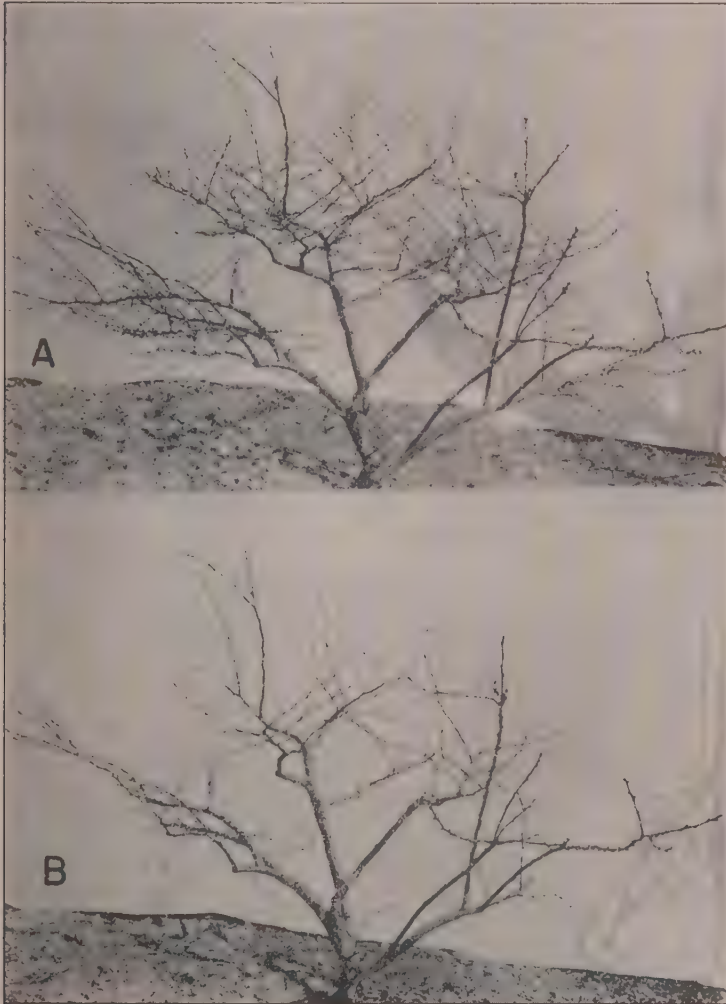


Figure 4. Pioneer. A. before Pruning; B. After Pruning.

Note bushy, spreading growth which requires more detailed and costly pruning than Rubel.

The pruning of the different varieties varies with the character of their growth. Some varieties, such as Rubel, sprout from the base much more freely than others, such as Jersey. After a few years varieties like Rubel will have many more old stems arising from the base and will require the cutting out of more of these stems than a variety like Jersey.

All varieties form small side branches, or shoots, in the top and benefit from the removal of the smaller, weaker ones. Many of the smallest and weakest, which are usually on the lower part of the branches, can be easily and quickly rubbed off with the hand protected by a heavy leather glove. The smaller and weaker of those remaining can then be quickly cut out with pruning shears. The removal of these excess shoots in the top is referred to as thinning out. Some varieties, such as Cabot, which produce many shoots, need more thinning out than such varieties as Pemberton, which form fewer shoots.

Varieties like Pioneer form many more fruit buds on each shoot than is desirable if fruit of maximum size is wanted. (See the three shoots on the right in



Figure 5. Rubel—Before Pruning.

(a) Terminal shoots with fruit buds; (b) old stem to be cut out.



Fig. 7.) To promote size with such varieties, it is necessary to cut back the shoots so as to leave only four or five fruit buds. Since this takes considerable time, it is doubtful whether it always pays. Other varieties, such as Rubel, form fewer fruit buds (see the three shoots on the left in Fig. 7) and need little or no cutting back.

As the above discussion suggests, the thinning of the crop is done by removing excess shoots and cutting back those remaining. The following outline of pruning practice is given as a general guide:

First, remove or cut back a few of the older stems such as (b) in Figure 5. These tend to produce short, weak shoots and small berries after they are several years old

Second, remove all branches so near the ground that their fruit will get dirty.

Third, thin out the top, removing the short, weak shoots.

Fourth, cut back shoots with too many fruit buds.

Finally, study the needs of the plants. Cut freely to encourage new growth. If pruning for the first time, seek expert advice.



Figure 6. Rubel—After Pruning.

(a) Desirable new shoots growing from the base of the plant.

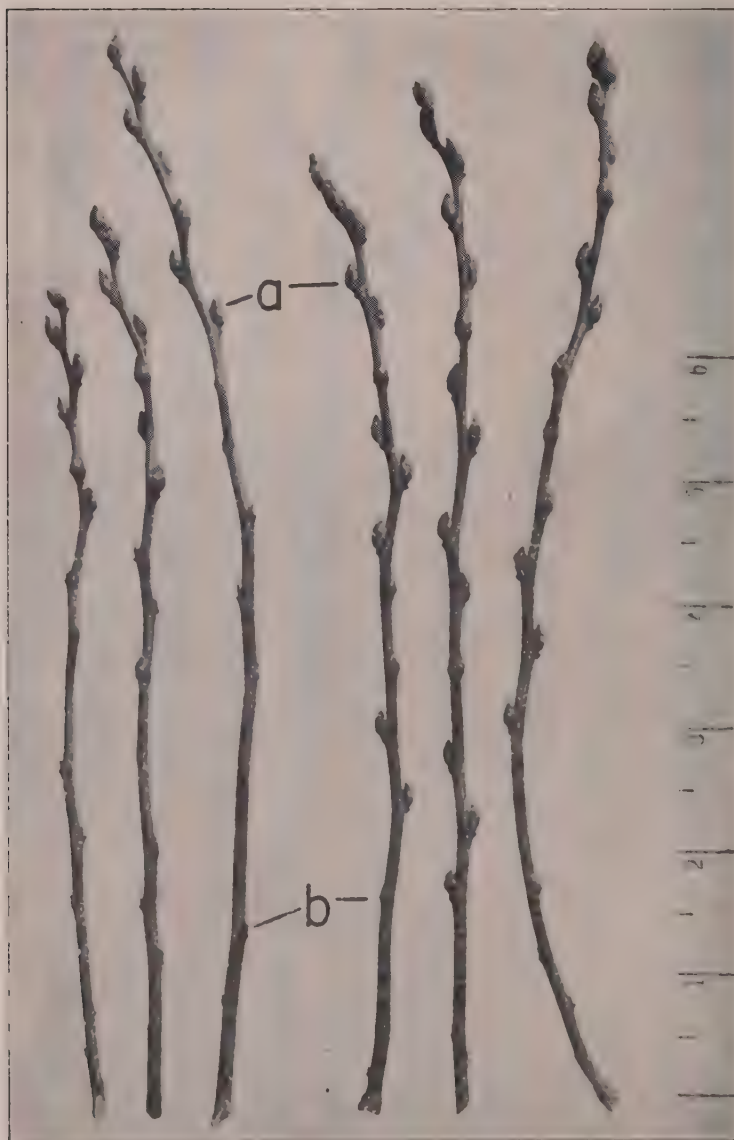


Figure 7. Terminal Shoots Showing Difference in Bearing Habit.  
Note differences in size and numbers of fruit buds (a) and leaf buds (b)





Figure 8. Blueberry Stem Borer.

A. Tip killed by egg-laying girdler; B. adult beetle; C. egg under bark; D. larva in tunnel; E. tip of branch killed by boring of larva.

## Insects and Diseases

The cranberry fruit worm, *Mineola vaccinii* Riley (6), sometimes attacks blueberries. The mature worm is about half an inch long. It has a yellowish head and a green body sometimes tinged with red on the back. It often webs several berries together and works among them. It can be controlled by dusting with a 4 or 5 percent rotenone dust at the rate of 50 pounds per acre, or a 2 percent activated rotenone dust at the rate of 60 pounds per acre. Two applications are needed: the first when the small green berries are about an eighth of an inch in diameter and the second a week later.

The blueberry stem borer, *Oberea myops* Hald., (4) sometimes damages the bushes considerably. The beetles (Fig. 8B) lay their eggs (Fig. 8C) in young shoots about six inches from the tip. The female girdles a shoot in two places about half an inch apart and deposits an egg in a slit in the bark between these girdles. The tip of the shoot then dies, turns brown, and often breaks off at the top girdle (Fig. 8A). When the egg hatches, the young larva bores down the center of the shoot (Fig. 8D). It continues this boring for two or three years and may even reach the roots. The infested stem usually dies (Fig. 8E). If the borer gets into the roots, it weakens the whole plant and the leaves turn yellowish or reddish.

This insect can be largely controlled by having the pickers break or cut off the dead tips while gathering the fruit. If the egg has hatched and the larva has started to bore, the shoot should be cut off below the lower end of the tunnel. Infested stems missed in the summer will usually be found during pruning the following winter and should be removed then. They may be dropped on the ground, for the larva is a legless grub and cannot crawl back to the bush. When the borers get into the roots, a piece of baling wire shoved down the tunnels will kill most of them.

The red-striped fireworm, *Aroga trialbamaculella* (Cham.), does some harm to blueberries at times. The larvae, which are pale green when small, develop reddish brown stripes along the back and sides as they grow older, till they appear to have a solid color unless closely examined. They fasten two or more leaves together and feed between them (Fig. 9). They make a tubular case of silk covered with brown castings. The injury to the older leaves is slight, but the stunting of new shoots by their work on the terminal leaves is more harmful. A thorough application of the following spray, about August 6, controls this pest:

|                                  |             |
|----------------------------------|-------------|
| 40 percent Nicotine Sulfate..... | 1 1/3 quart |
| Fish-oil Soap.....               | .4 pounds   |
| Water.....                       | 100 gallons |

White grubs, the larvae of June beetles, *Phyllophaga* sp., injure blueberry plants seriously by eating the fibrous roots. They are usually troublesome in the propagating bed in dry seasons unless excluded by a fine metal screen, coarse gravel or cinders under the bed. Plants set on land recently in sod are very subject to attack. This can be prevented by keeping the land fallow for a year before planting. If plants must be set following sod, 25 pounds of DDT or 10 pounds of chlordane per acre, worked into the soil, is good insurance. Mature bushes sometimes become infested. A solution of sodium cyanide, 7 ounces in 100 gallons of water, applied around the crowns at the rate of 2 gallons per square foot, kills most of the grubs. *The cyanide is a deadly poison, and must be used with care.*

Caterpillars of the gypsy moth, *Porthetria dispar* (L.), sometimes do considerable damage but are very easily checked by dusting with 3 percent DDT. The sooner this dust is applied after the caterpillars appear, the more good it will do.





Figure 9. Red-Striped Fireworm Injury on Blueberry.

Red-humped caterpillars, *Schizura concinna* Smith and Abbot, sometimes attack the blueberry. In August or September when they are young, they feed in colonies and can strip a branch of leaves in a short time. At this stage, they can be shaken from the bush and crushed, or the infested branches can be cut off and destroyed. Where they are abundant and the crop is entirely off, spray with lead arsenate, 4-5 pounds to 100 gallons of water. Pyrethrum dust may be used if the crop is not all harvested.

The cranberry spittle insect, *Clastoptera saint-cyri* var. *saint-cyri* Prov., infests blueberry bushes occasionally. It is a sucking insect about an eighth of an inch long, appears usually in early June, and covers itself conspicuously with froth. It is controlled by spraying with:

|                       |              |
|-----------------------|--------------|
| Nicotine Sulfate..... | 1 1/3 quarts |
| Fish-oil Soap.....    | 4 pounds     |
| Water.....            | 100 gallons  |

The blueberry fruit fly or blueberry maggot, *Rhagoletis pomonella* Walsh (recently described as *R. mendax* by Curran), is a very troublesome pest of wild blueberries in some sections. It is present in Massachusetts, but is not

yet generally troublesome on cultivated berries. The adult is a fly, like that of the apple maggot but smaller, appearing in late June and early July. The female lays her eggs under the skin of soft, overripe berries. The eggs hatch into small, light-colored maggots, one fourth to one third of an inch long, which work inside the berries. When infested berries fall to the ground, the larvae enter the soil, where they pupate and pass the winter. The following summer the flies emerge to infest the fruit again. The first flies emerge just as the first berries begin to ripen and emergence continues during the picking season. Since the eggs are laid under the skin of the berries where they cannot be reached by any insecticides, the adult flies must be killed before egg laying begins. Control can be obtained by dusting with a 2 percent rotenone dust at the rate of 70 pounds per acre. The first application will be needed when 2 to 3 percent of the berries are ripe. For good control at least three, and four is better, applications at 10-day intervals are necessary. The accumulation of very ripe berries in the field should be prevented by picking at least once a week. Removing wild bushes around the field also helps control.

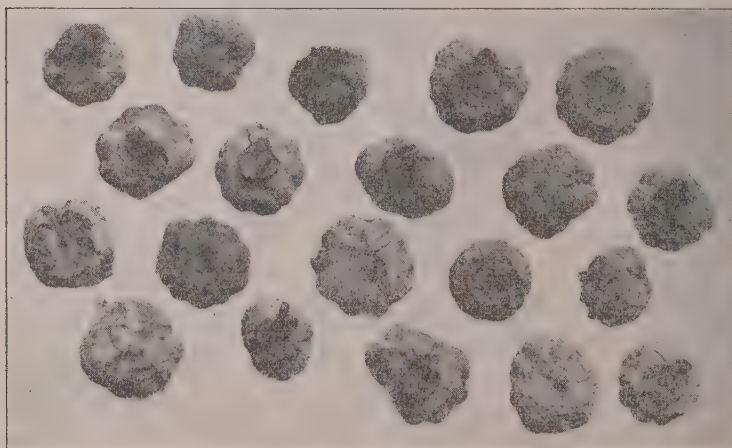


Figure 10. Mummy Berries.

Mummy berry is the most troublesome disease of cultivated blueberries in Massachusetts. It is caused by a fungus, *Monilinia vaccinii-corymbosi* (Reade) Honey, which rots and mummifies the green or partly ripe fruit badly in some years. The gray, dry, shriveled berries, or mummies (Fig. 10), are found on the ground under infected bushes in late summer. These mummies may remain dormant for as long as four or five years, but toadstool-like growths, called apothecia, may develop from them during the blooming season the next spring (Fig. 11). Millions of spores shoot forth from the cups on the top of these apothecia to infect the new crop. Infection of the small developing green berries probably takes place during the blooming period. Sometimes tender new shoots become infected, wilt, and turn black. This is called shoot blight (Fig. 12A) and is easy to confuse with frost injury. Whole clusters of blossoms may become infected, turn brown, and die. This is the blossom blight form of the disease (Fig. 12B). Spraying the bushes has not been very effective in controlling this disease. Where cultivation is practiced, the mummified berries can be raked to

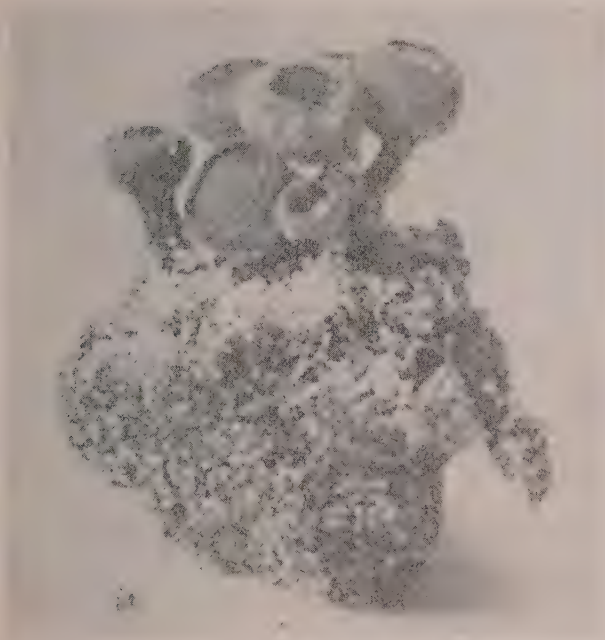


Figure 11. Mummy Berry Disease.

Apothecia arising from a single mummy with soil and other extraneous matter adhering to it.

Photo by courtesy of the Bureau of Plant Industry, Soils, and Agricultural Engineering, United States Department of Agriculture.



Figure 12. Mummy Berry Disease. A. Shoot Blight. B. Blossom Blight.





Figure 13. Blueberry Stunt Diseases.  
The shoot on the left is healthy; those on the right are infected with stunt.



Figure 14. Blueberry Stunt Disease.  
The bush has been infected for several years and is in an advanced stage of the disease.

the middle of the rows before bloom. Then two or three cultivations during bloom will destroy the apothecia as they form and give considerable control. A ground spray of a dinitro such as Elgetol, 4 quarts per 100 gallons at the rate of 500 gallons per acre, applied just before bloom also gives considerable protection. This spray kills the apothecia which are formed on the mummies.

The blueberry stunt disease has become very serious in New Jersey and North Carolina. Although it is present in Massachusetts and a few cases are found each year, it has not yet become serious in this State. This is a virus disease which infects the whole bush. Diseased bushes cannot be cured. They must be pulled out and burned as soon as found. The typical symptoms are as follows: In early summer the new leaves turn yellow between the veins giving a green and yellow mottled appearance. They are small and cupped, usually toward the lower side of the leaf. Growth is much reduced so that the internodes are much shortened. Many buds start growth and produce short, weak shoots giving a very brushy appearance. This condition is shown in Figure 13. In late summer, before time for normal coloration, the leaves turn red but the midrib remains a dark, bluish green. In the early stages of this disease only a single branch may show symptoms. Later the whole bush will show them (Fig. 14). If stunt-infected bushes are pruned, they never grow enough to replace the wood removed and gradually become smaller and smaller.

It has recently been reported from New Jersey (11) that this disease is spread by two sharpnosed leafhoppers, *Scaphytopius magdalenensis* (Prov.) and *S. vercundus* (Van D.). The former species is common in southeastern Massachusetts.

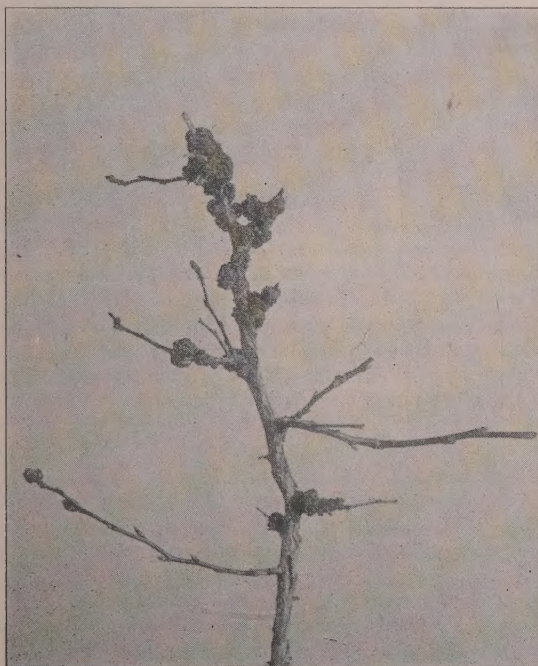


Figure 15. Phomopsis Gall, a Fungus Disease of the Blueberry.

A twig blight of blueberries is caused by a fungus, *Phomopsis vaccinii*, which causes a decay of cranberries (13). The fungus enters tender tips and travels down and kills the shoots. It may enter older branches and girdle them so that all parts above the girdle die. Infected parts of plants should be cut out and burned. This disease is of minor importance.

Phomopsis gall is due to a different *Phomopsis* from that causing the twig blight. It was formerly mistaken for crown gall, a bacterial disease. It appears as knotty swellings on the stem or branches (Fig. 15), and has been observed on several varieties, but Cabot, Concord, and Rancocas are the most susceptible. Wet soil favors it. It is spread by using cuttings from infected plants and is, therefore, mainly a nursery trouble. It can be eradicated by persistently removing and burning diseased bushes.

Birds, particularly robins and starlings, are among the worst pests of cultivated blueberries. They often take a large part of the crop in small plantings. Their depredations are not so marked in large fields. Inflated paper bags hung on strings so they will dance in the wind help keep birds away.

### Harvesting and Marketing

The sale of cultivated blueberries at good prices depends on offering the consumer an attractive product of high quality. This means that care in picking is essential. For best flavor and shipping quality the berries must be neither too green nor too ripe. The stem end of ripe berries has a dark, rich, blue color. A reddish tinge there indicates immaturity. Underripe fruit is sour and lacks blueberry flavor. Most varieties need picking every six or seven days. Periods of abnormally cool or hot weather will vary this at times.

The berries are covered with a light blue waxy substance, or bloom, which gives them their attractive appearance. Since this is easily rubbed off, the berries will look much better if handled as little as possible. Picking directly into the containers in which the berries are to be sold avoids much handling. A better and more attractive pack will be obtained if good, reliable pickers are employed and given adequate supervision.

Little grading is done in Massachusetts as yet. In New Jersey, where the fruit is sold through a cooperative organization, all berries for the fresh fruit market are graded to fixed standards. Grading is done partly by the pickers, who pick only sound berries, and partly in the packing shed, where the baskets are sorted according to the size of the berries they contain. New Jersey growers use pint baskets. Massachusetts growers use both pints and quarts, although pints are the more popular.

The baskets are often covered by a piece of cellophane held in place by a rubber band. This cellophane often has a design and the grower's name or a brand name stamped on it. Although cellophane adds to the attractiveness of the pack, moisture sometimes collects underneath it. This is undesirable because it impairs the keeping of the berries.

Most of the cultivated berries are grown in New Jersey and Michigan. There are small areas in Massachusetts, North Carolina, and Washington. North Carolina growers are planting early varieties; New Jersey growers, mid-season and late ones.

Prospective blueberry growers should consider the following: growing late varieties reduces to a minimum competition from berries shipped from farther south; growing varieties which are easily propagated and cheaply pruned keeps down production costs; care in the location of plantings helps prevent costly failures; location near main traveled roads facilitates roadside sale at retail prices.



### The Improvement of Wild Highbush Blueberries

There are many acres of wild highbush blueberries in this State where the bushes are yielding much below their capacity because of lack of care. They can be made to double or triple their yield without great expense or labor.

In 1926 experiments were tried on blueberry land in Hubbardston, Royalston, Westminster, Ashburnham, and Barre, Massachusetts, to increase the yield of wild bushes. The treatments were as follows: all large trees and second growth shading the blueberries were removed, the bushes were pruned, fertilizer was applied. The pruning varied from removing a quarter of the bush to cutting it wholly to the ground. The fertilizers used were nitrate of soda, ammonium sulfate, urea, calurea, cyanamid, 4-8-4, and nitrophoska. Different combinations of fertilizers and pruning were tried.

The following results were observed:

1. Removal of other vegetation increased the growth of the blueberry bushes.
2. Pruning, where not excessive, increased growth and yield. Removal of more than a quarter of the bush was too severe. Bushes cut to the ground yielded a few berries the third year thereafter but produced no commercial crop till the fourth year.
3. Fertilization increased the growth and yield of the bushes. The increase seemed to be due to nitrogen rather than to any other fertilizer element.
4. A combination of fertilization and pruning was much better than either alone.
5. The increase in production on the fertilized plots was due mostly to an increase in the number of berries per bush. It was impossible to obtain satisfactory comparative yield records under the conditions of the experiments. The bushes varied in size and number per acre. Although the pickers were assigned to different parts of the field, they picked in the fertilized plots whenever possible, with or without permission. This is very good evidence of the better picking found there.
6. The berries on the fertilized plots tended to be larger, but the size of wild berries varies greatly and cannot be increased beyond limits set by inheritance.
7. Fertilized bushes had a marked tendency to bear yearly; unfertilized bushes to bear in alternate years.
8. The berries on the fertilized plots were firmer during dry periods than those on unfertilized areas.
9. A terminal shoot growth of about ten inches was best. Any increase in length up to ten inches increased yield. Longer shoots were apt to be too vegetative for maximum production.

These observations are the basis for the following improvement program:

First, remove all trees and bushes shading the blueberries. This will often supply the winter's wood, thus making the labor serve a double purpose. If valuable timber trees are present, the owner must choose between blueberries and timber. The mowing of low bushes growing with the blueberries helps also.

Second, prune the blueberry bushes in winter or early spring before growth starts. Take out all dead wood first, then some of the oldest stems, cutting them off four or five inches from the ground. This can be done best with long-handled lopping shears.

Third, fertilize the bushes. Apply 200 pounds of nitrate of soda per acre, or some other nitrogenous fertilizer at a rate to give a like amount of nitrogen.

Fourth, select and tag the more productive bushes and give them special care.

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